

The Inland Petroleum Distribution System in Kuwait and Iraq

By Captain Anthony De Simone and Major Norm Gauthier

On 14 January 2003, the 62d Engineer Battalion (Combat)(Heavy) from Fort Hood, Texas, deployed to the Kuwaiti U.S. Army Central Command (CENTCOM) area of operations in support of Operation Enduring Freedom. The 62d was the first combat engineer battalion in country and was assigned as a direct-reporting unit to the 416th Engineer Command, the theater-level engineer command from Chicago, Illinois. The unit's job would be to construct the Inland Petroleum Distribution System (IPDS) in preparation for an attack on Iraq—a mission usually reserved for one or more engineer pipeline companies, which are all reserve units. The IPDS would be constructed from Camp Virginia, Kuwait, to Logistics Support Area (LSA) Adder (near Tallil Air Base), Iraq, a distance of about 224 miles. The pipeline was essential, as one of the Combined Forces Land Component Command's (CFLCC's) prestart conditions for the war with Iraq was the completion of the IPDS to Breach Point West on the Kuwait-Iraq border.

Upon receiving the mission, we contacted the 808th Engineer Company (Pipeline) in Houston, Texas, to learn about the construction of an IPDS. They sent us the training manuals and CDs, but we were unable to go to Houston for training due to the short deployment suspense. Eventually, the battalion received the 226th Engineer Company (Combat) (Heavy) and the 808th Engineer Company (Pipeline) in February and March, respectively. The battalion strength averaged 750 soldiers during the time period when the IPDS was constructed.

IPDS

The IPDS is a rapid deployment, general support, bulk fuel storage and pipeline system manufactured by Radian, Inc. The system has a design throughput of 720,000 gallons per day based on 600 gallons per minute at 20 hours per operational day. The IPDS is transported in military vans (MILVANS) and packaged in sets containing materials to construct a pipeline 5 miles long. Each set fills 13 MILVANS. There are 1,404 sections of pipe, 19 feet long and 6 inches in diameter, that fill nine of the MILVANS. The other four MILVANS contain necessary pipeline parts such as couplings, elbows, hammers, retaining pins, and gate and check valves.

The 19-foot-long sections of pipe are made of aluminum with variable wall thickness. These sections cannot be cut. Instead, each 5-mile set contains 44 pieces of 9-foot-6-inch-long pipe with constant wall thickness that can be cut to length



A soldier from the 62d Engineer Battalion couples a section of the pipeline while an oil fire burns in the background.

and regrooved. Each piece of pipe is designed with a special single-groove design in order to join pipe sections. When two pieces of pipe are joined, snap-joint coupling clamps hold them together. Each clamp has an integral gasket that makes pipe connections relatively easy. Before installing the coupling, a light coat of petroleum lubrication is applied to prevent the gasket from adhering to the metal pipe in extremely hot temperatures. The coupling holds the pipe sections together by wrapping around the grooves on the ends of the two sections of pipe. The coupling is closed with a special tool (included with the set) and is held shut by hammering a retaining pin into place.

There are a few guidelines to follow when constructing the IPDS. The aluminum pipe used in the IPDS is highly reactive to changes in temperature. Expansion and contraction of the

Report Documentation Page				Form Approved OMB No. 0704-0188	
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1. REPORT DATE SEP 2003		2. REPORT TYPE		3. DATES COVERED 00-00-2003 to 00-00-2003	
4. TITLE AND SUBTITLE The Inland Petroleum Distribution System in Kuwait and Iraq				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Engineer School,14010 MSCoE Loop BLDG 3201, Suite 2661,Fort Leonard Wood ,MO,65473-8702				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 6	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			



Soldiers from the 808th Engineer Company construct a pump station in Kuwait.

pipeline can move it almost 2 feet per 50 sections of pipe. Each coupling is designed to handle 4 degrees of deflection, so it is important to control the amount of expansion and contraction. Some ways to control the expansion and contraction are to—

- Install the pipeline as straight and level as possible.
- Make any change of direction by using elbows.
- Construct anchors and “U” or “Z” expansion loops at certain intervals.

Another thing to consider when constructing the IPDS is maximizing fuel flow. To do this, we needed to install pump stations, which consist of two 800-gallon-per-minute mainline pumps, a launcher to launch a pig (a scraper that passes through the line to

clean it), and a receiver to catch the pig. The pump is best moved by a rough terrain cargo handler or crane. The launcher and strainer weigh about 2,800 pounds each.

Once the IPDS is constructed, it has to be filled and flushed before placing it in operation. The pipeline is designed to run at 600 gallons per minute with each pipe section having a maximum allowable operating pressure of 740 pounds per square inch. Water is pumped into the pipeline and a pressure check is conducted. Once the pipeline passes the pressure check, a pig or scraper is passed through the pipe via the launcher and caught by the receiver. The pig scrapes the sides of the pipe, removing any sand or debris before fuel is added. Behind the pig, fuel is pumped into the pipeline. Once the pig is received at the pump station, that section of pipe is charged with fuel and ready to operate. If there are any problems along the way, a repair crew closes the gate valves and repairs that section of pipe. After these tests are conducted, the pipeline is operational.

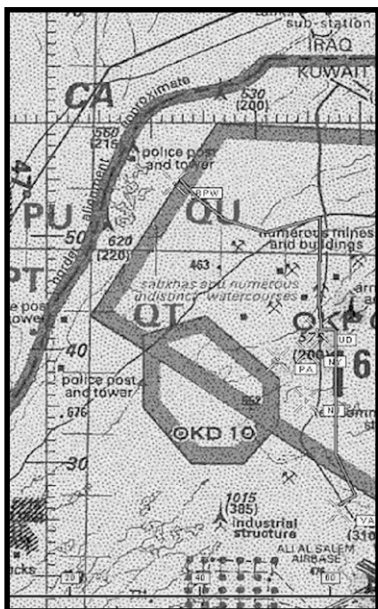
To deliver fuel from the pipeline, tactical petroleum terminals (TPTs)—run by quartermaster units—are set up at desired intervals. The mission of the TPTs is to receive, store, and dispense fuel, and millions of gallons of fuel can be stored or delivered to tankers or other vehicles.

How We Did It

Since the war was still months away, we could not construct all 224 miles of pipe simultaneously. As a result, we broke the mission into five segments, IPDS I through IPDS V.

IPDS I

IPDS I stretched from Camp Virginia to Breach Point West (about 51.5 miles) near the Iraq border in preparation for a ground assault. Because we had so many miles of pipeline to construct, six pump stations and two large TPTs to build,



IPDS I runs from Camp Virginia through Camp Udairi to Breach Point West.



Alpha Company, 62d Engineer Battalion, transports pipe by loading three MILVANS on a lowboy.

and the TPT at Camp Virginia to expand, we broke the pipeline trace into company sections. They then broke their sections into platoon sections. Each company was given a section of the trace and daily goals to meet. At the start of the pipeline, we only had three line companies. We used a planning factor of 2 miles per day per company or about 6 miles per day for the battalion. We trained our leaders on the IPDS on 24 January. Our trainer had been in the 515th Engineer Company (Pipeline) during Operations Desert Shield and Desert Storm, when the company laid more than 100 miles of pipeline. Due to the short duration of the war, that pipeline was never used to pump fuel.

Since our ship had not come into port yet, we borrowed transportation assets (5-ton cargo trucks and high-mobility, multipurpose wheeled vehicles [HMMWVs]) and sent two vertical platoons, one each from Alpha and Bravo Companies. We reserved the other two vertical platoons for port download operations. Construction of the IPDS from Camp Virginia to Camp Udairi began on 28 January 2003.

The ship with our equipment arrived in port on 31 January, and we began download operations the following day. With commercial and heavy equipment transport, we moved the battalion from Camp Arifjan to Camp Udairi on 7 February. We set up our base camp operations, and the next day all six vertical platoons were working on their assigned sections of pipeline. Our plan was to stage two 5-mile sets every 10 miles, but external transportation assets were in demand and routed elsewhere. As a result, we used our M916/M920 and M870 trailers to move pipeline and our 25-ton all-terrain cranes to load the MILVANS.

Pipeline construction continued at a rapid pace as Bravo Company moved its command post to a location just outside of Breach Point West and started construction from there back toward Camp Virginia. The 10-mile segment was primarily on flat ground but incorporated three large crossing sites for maneuver forces. Each 5-mile set of pipeline comes with 80 feet of 24-inch nestable culvert. We were tasked to build ten 100-meter (approximately 328 feet) crossing sites over the

51.5-mile trace, and there were several sites where the pipeline crossed the main supply route (MSR). Since these crossing site requirements exceeded the supplies in the pipeline set, we contracted for the delivery of hundreds of pieces of 19-foot-long PVC culvert with a 13-inch diameter. We modified the pipe layout to ensure that we had gate valves and expansion loops before each large crossing site. By digging with the hydraulic excavator (HYEX), the crossing sites were emplaced easily and didn't hamper progress.

One section of IPDS I that we called the "moonscape" required special attention. It was a 5-mile-long section that passed through rough terrain and sand dunes. The equipment platoon from Headquarters Support Company spent 9 days with seven dozers leveling this area before pipe could be laid there. In all, it took 21 days to complete IPDS I, 5 days ahead of schedule. However, it took the quartermaster personnel an additional 21 days to fill and test the line. Normally, the pipeline construction company would have performed this task, but it had not yet arrived in country. One of the lessons learned for our construction of IPDS II was to incorporate time into the work schedule to fill and test the line.

IPDS II

As the possibility of war increased, the CFLCC projected a larger daily requirement for fuel at Breach Point West. As a result, we needed to construct an additional pipeline parallel to IPDS I. There was one consideration in constructing this section. Pipe and pump stations were only estimated for one pipeline to reach approximately 205 miles. By constructing this second pipeline, issues would arise later on that might prohibit the pipeline from reaching LSA Adder. Equipped with many lessons learned from IPDS I and the addition of the 808th Engineer Company, the battalion was able to complete IPDS II with ease. Alpha and Bravo Companies and the 226th Engineer Company concentrated on pipeline construction, and the 808th focused on pump station construction and filling and testing the line. Headquarters Support Company cleared another trace through the moonscape with Bravo Company.

Challenges

Transportation. External transportation assets were always in high demand. We were forced to transport MILVANS to worksites a few at a time with internal haul assets (M916/M920 and M870 trailers, as well as the Palletized Load System [PLS] with flatracks). Using internal assets, we averaged 6 to 8 miles of pipeline constructed per day. With dedicated PLS support, we constructed 34 miles of pipeline in a 2-day period.

Water. Getting the water required to flush and fill the pipeline was difficult, and we experienced several delays waiting for water. In the end, most of our water requirements had to be contracted out and brought in by commercial assets.

MOPPI. After the completion of IPDS I and II, the ground war started, and all units went into MOPPI. Progress on IPDS III into Iraq slowed because now the soldiers were in MOPPI and wearing flak vests in temperatures near 120 degrees. Drinking water was essential, as were timed breaks for soldiers. Pipeline sections now took two to three times as long to construct as those constructed before the war.

Rough Terrain and Sandstorms. Most terrain in the desert was flat and ready for pipeline construction. The section in Kuwait that we called the moonscape was difficult to work through. Many days were spent and thousands of tons of sand were moved to prepare the site. At times, sandstorms reduced visibility to less than 20 yards and prevented the pipe seals from staying free of debris. The rough terrain and sandstorms also made it impossible to align the pipeline for anchoring.

Crossing Site Adjustments. A pipeline set includes 80 feet of nestable culvert. We had to build crossing sites 100 meters across for tracked-vehicle maneuverability. Luckily, we were able to obtain 19-foot lengths of 13-inch diameter culvert from Camp Doha and link the pieces together to span the required length.

Extended Lines of Communication. We worked on sections of the pipeline that spanned more than 60 miles at a time. Communications became an issue when our FM radios did not transmit the entire distance. To overcome this problem, we set up retransmission sites in Kuwait. In sections in Iraq, we set up base camps every 15 to 20 miles to maintain communication between base camps.

Tricks of the Trade

Quality Assurance/Quality Control Inspections. Building pipeline can be monotonous, and it was important that the S3 section constantly inspect the construction. Often, we identified and corrected mistakes before they caused major problems. We also checked the line with members of the quartermaster unit that took over the pipeline. If the unit identified any problems, we corrected them before turning the pipeline over to the unit. Another valuable asset was the representative from Radian, Inc., who was in theater throughout our construction of the pipeline. He was truly the expert on constructing the pipeline and pump stations.



The battalion's Bobcats were invaluable in constructing the pipeline.

Internal Transportation and Flatracks. We planned for and requested external transportation but also planned for completing the mission without it. We also requested flatracks for our PLS trucks. This asset enabled us to conduct our own transportation of pipeline MILVANS and pump stations. We did not have the volume of vehicles we would have liked, but we managed to keep our trucks with pipeline MILVANS one day ahead of the soldiers constructing the pipeline.

Lessons Learned

Pipeline Construction. Break the unit into several sections by platoon and give them goals.

Construction Meetings. With our limited assets, a detailed construction meeting was a must. Each commander reported progress and identified equipment needs (from Headquarters Support Company or other) for the following 24 to 48 hours. These were addressed to minimize confusion and lost time and to maximize construction effort the following day.

Security. As you lay and couple pipe, the site moves forward, so security must also be mobile. We used two soldiers at each end of the mobile construction site with the M249 squad automatic weapon (SAW) on top of a vehicle to provide clear lines of sight. We increased this in Iraq by using the M2 .50-caliber machine gun, MK-19 grenade launcher, and AT-4 antitank weapon.

Transportation. You need a dedicated transportation unit with 14 or more PLS vehicles. These will greatly reduce the amount of internal haul assets and increase the productivity of the soldiers constructing the pipeline.

Protecting the Pipeline. The only thing we found effective at protecting the pipeline in the desert conditions was berms. We initially constructed 3-foot berms but found that HMMWVs could still go over the top. As a result, we built dual 6-foot berms.

Bobcats®. The battalion received four Bobcats with all attachments before the pipeline construction began. They were a great asset in pump station construction. We used them for installing both gate and check valves, which are too heavy to lift without several soldiers.

Another consideration when constructing the pipeline was how to protect it. At the time, there were many maneuver units in the area preparing for a ground assault into Iraq. Our initial plan to protect and mark the pipeline was to use 8-foot-tall pickets, flying 3 feet of white engineer tape, every 100 meters. CFLCC then issued a fragmentary order to inform all commands of the location of the pipeline and instruct them not to cross over it. With fuel at 700-plus pounds per square inch, it could be dangerous if the pipe ruptured. While this method may have marked the pipeline, it did not protect it. We then constructed a 3-foot-high berm on one side of the pipeline, which also failed to protect it. Finally, we constructed a 6-foot berm on both sides of the pipeline, and this method proved to be effective. For four weeks, all the dozers in the battalion worked at constructing more than 130 miles of 6-foot berm for IPDS I and II from Camp Virginia to Breach Point West (to include force protection berms for the pump stations and TPTs).

This time, IPDS II (the same 51.5 miles as IPDS I) only took the battalion 12 days to construct and 5 days to fill and test. We finished on 18 March and fulfilled the CFLCC requirement for fuel prior to the ground war. With IPDS I and II complete, there were 103 miles of pipe on the ground, enough to sustain V Corps and I Marine Expeditionary Force (MEF) ground and rotary-wing combat forces.

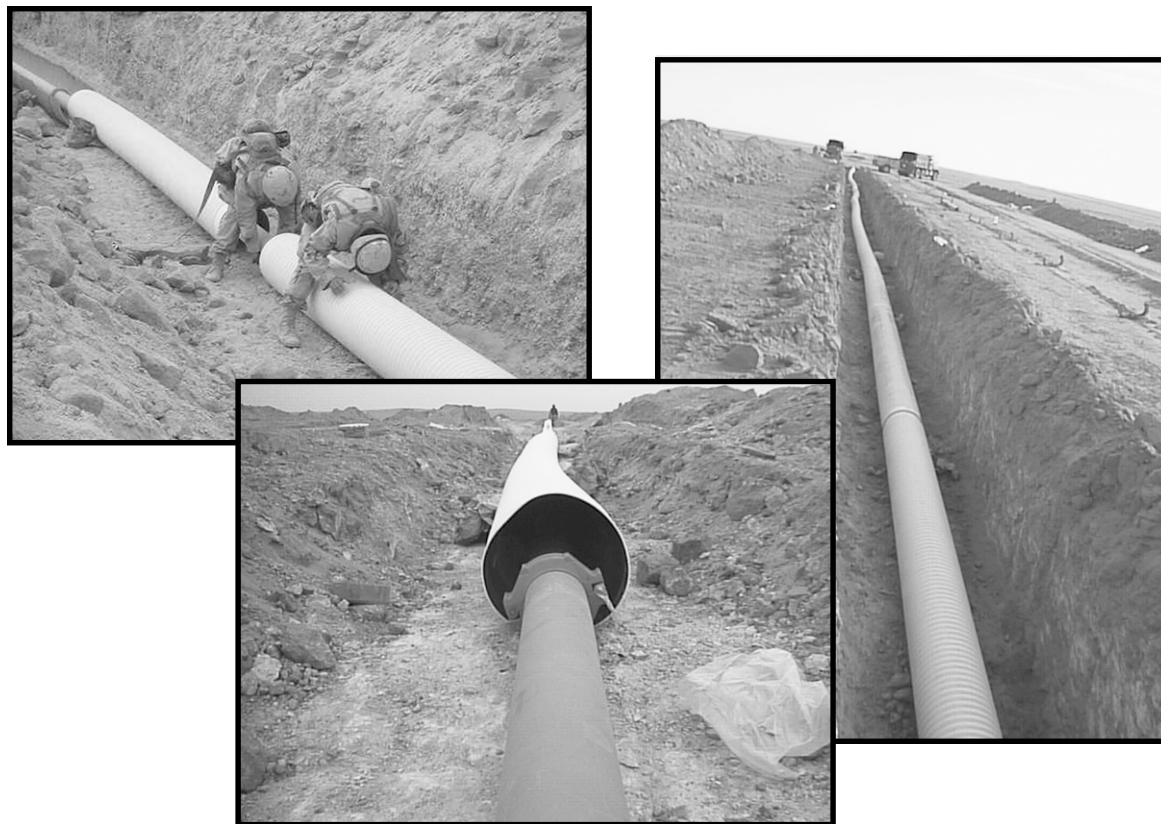
IPDS III

IPDS III began a few hours after the ground war started. The team, consisting of a HYEX and two squads from the

808th, was attached to the 6th Engineer Support Battalion, Marines out of Oregon. They crossed the border and began digging crossing sites so the battalion could follow with pipe without delay. On 22 March, the remainder of the battalion crossed the border and secured their base camps in Iraq. To maintain FM radio communication, each company established its base camp within radio communication distance. As a result, the battalion had uninhibited communication throughout the area of operation for the new pipeline. This section of the pipeline stretched from Breach Point West in Kuwait to LSA Viper in Iraq, a distance of 58 miles.

Since we were now in a combat zone, soldiers had to take additional safety precautions. For the first three weeks of pipeline construction in Iraq, soldiers worked in their Joint Service Lightweight Integrated Suit Technology (JSLIST) suits (at mission-oriented protective posture [MOPP] level 1), flak vests, and full combat load of ammunition. With all of this gear, production dropped to less than a mile of pipe constructed per day per company, a 50 percent decline in productivity. This reduction was acceptable, as completion dates had been adjusted accordingly.

IPDS III, consisting of 58 miles of pipeline and four pump stations, was finished on 14 April, ahead of schedule. Before the ground war, the initial goal for IPDS III was to extend to Tallil Air Base near LSA Adder. However, a few days into the war the area was still not secure from enemy activity. Consequently, the plan changed from reaching LSA Adder to reaching LSA Viper instead.



A crossing site at MSR Iron Horse Trail



Engineers lay pipe for the IPDS.

IPDS IV

By the time the pipeline reached LSA Viper, LSA Cedar I was secured and was ready for fuel delivery. IPDS IV would extend an additional 29.5 miles from LSA Viper to LSA Cedar I. Construction on two additional pump stations began on 15 April. Each company was given about 10 miles to complete, and progress went smoothly. We were now a seasoned pipeline construction unit, anticipating problems before they occurred. Alpha and Bravo Companies and the 226th continued to construct the pipeline while the 808th focused on pump station construction and filling and testing the pipeline.

An important thing to consider when filling and testing the pipeline is the availability of water. This requirement was always an issue throughout this process. We were in the desert, and water was scarce. To complete the filling and testing, we had to contract local tanker companies to haul water to fulfill our requirements. IPDS IV was completed on 20 April without a hitch, merely 5 days after it was started.

IPDS V

Just when we thought we were done with pipeline construction, we received orders to continue the pipeline to LSA Cedar II, north of LSA Adder. This section would extend the pipeline an additional 34 miles and require three pump stations. However, since we constructed IPDS I and II in Kuwait, we had used more pipe than we scheduled for, and there were no pump stations in country to continue IPDS V.

Simultaneous to our pipeline construction, the Kuwaitis had completed a contract for a fuel pipeline from Camp Virginia to Camp Udairi, so IPDS II was no longer needed. We decided to send platoons from Bravo Company to recover this pipe to construct IPDS V. A platoon from the 226th leveled the berms, and the 808th removed the pump stations. In order for the pipe to be recovered, it had to be flushed with water, uncoupled, and air-dried before handling.

Platoons from Alpha Company and the 226th constructed IPDS V as fast as pipe could get to them and finished it on 13 May. Then the battalion withdrew from Iraq—one company at a time—into base camps in Kuwait and waited for further missions.

Conclusion

When the pipeline construction was finished, the 62d Engineer Battalion had completed the longest operational IPDS ever constructed by the Army. More than 720,000 gallons of fuel could be pumped daily from Kuwait into LSA Cedar II in Iraq, a distance of 224 miles. The soldiers of the battalion moved more than 66,000 pieces of pipe, weighing 4,500 tons. The battalion learned many lessons from conducting this mission. Although a pipeline can be constructed without a pipeline company, we found that with the assistance of the 808th Engineer Company, the battalion's efficiency greatly increased. The 808th also was able to reduce the fill-and-test process by several weeks, which enabled the battalion to meet every deadline early. The 62d Engineer Battalion's success can be attributed not only to having a good plan but also to having superior noncommissioned officers and motivated soldiers. Ensuring that they knew the importance of this mission was directly correlated to the success of the CFLCC mission.



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